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POST-OPERATIVE SEPTIC PERITONITIS.

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Between January 18th and 25th, 1893, five laparotomies were performed and four of these patients died. In all of the fatal cases the operation was a simple one and the abdomen at the time of operation was apparently perfectly clean. The fifth case was one of pyosalpinx. This patient, however, recovered. The autopsies were performed in the Pathological Laboratory of the Johns Hopkins Hospital and University under the guidance of Prof. Welch and Dr. S. Flexner. A detailed description of the fatal cases is as follows:

CASE I.

CLINICAL HISTORY.

History. E. H., æt. 34, admitted in the service of Dr. Kelly, January 12, 1893. Complaint: profuse menstruation, accompanied by a tumor in the lower abdomen. Menstruation began at thirteen, was always regular, and lasted five days. For the last six months previous to admission it lasted seven to eight days, was rather profuse, but not painful. Last menses Jan. 5th. Family history: Mother died of phthisis; several members of the family had rheumatism.

History of present illness. Five years ago a tumor the size of a hen's egg appeared just below and to the right of the umbilicus; this was not painful and apparently had no effect on the menses. One year and a half ago it began to increase rapidly in size and at the same time menstruation became more profuse. Pressure on the tumor produces a sickening sensation. On inspection the abdomen below the umbilicus is slightly distended. Palpation reveals a hard, irregularly rounded mass about 12 cm. in diameter. This commences about 1 cm. above the pubis and extends to the level of the umbilicus. The greater part of the mass is to the right of the mid-line. The whole tumor is quite movable. Per vaginam: the posterior vaginal wall is found to be distended with a large, hard, rounded mass. This fills up the greater part of the pelvis. The



cervix can be felt far up on the right side, being situated immediately behind the symphysis pubis.

OPERATION.

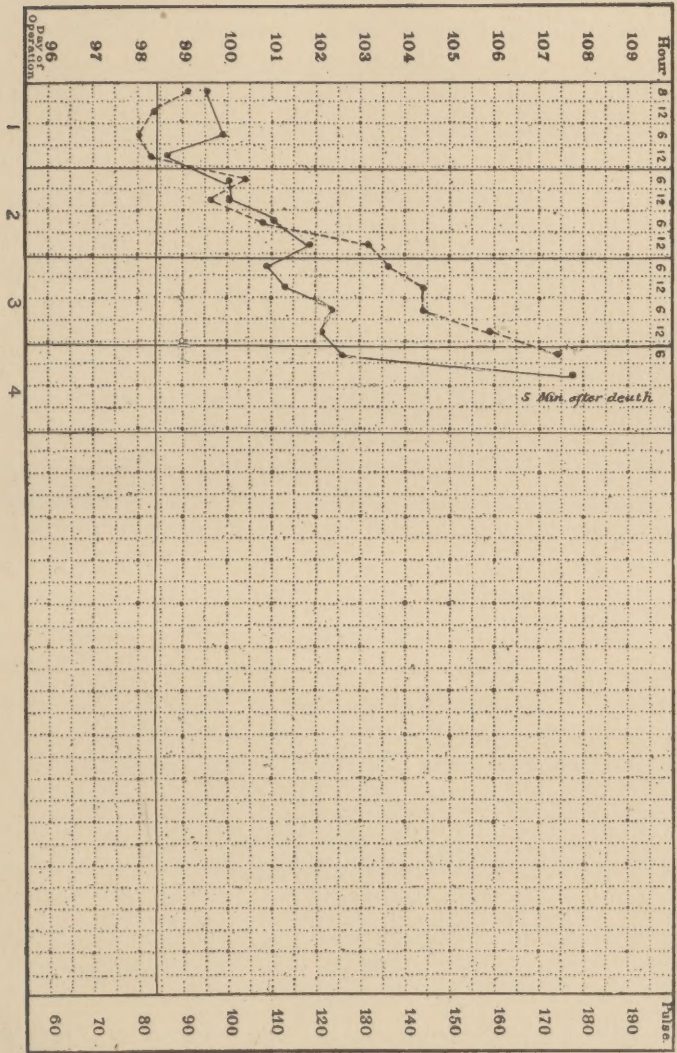
Operation, myomectomy by Dr. Kelly, Jan. 23d, 1893. An incision about 14 cm. long was made in the abdominal wall. This exposed a globular tumor which accurately fitted the pelvis, reminding one of a ball and socket. On fully exposing the uterus a tumor 8.5 cm. in diameter was found in the anterior wall; a similar nodule 8.5 cm. in diameter could be felt in the posterior wall. The uterus being retroflexed, the posterior nodule had been caught beneath the promontory of the sacrum. Incisions were made over these nodules, and they were enucleated from the uterine tissue which covered them to a depth of 1 cm. The cavities so produced were obliterated by catgut sutures which approximated the walls. Several smaller myomatous nodules were also enucleated. The uterus was restored to its normal position and the abdomen closed by four series of buried catgut sutures. A few superficial silk sutures were used to obtain accurate skin approximation. Duration of operation 34 minutes.

Jan. 24th, 1893, 11.45 P. M. The patient complained of severe stabbing-like pains over the area of lower lobe of left lung. The pain was increased on deep inspiration. Tongue was moist, slightly coated. Abdomen not distended.

Jan. 25th. Pulse rapid, fair in volume, 120 to the minute. Her expression was bad. She has been nauseated at intervals during the entire day. Tongue slightly coated. The abdomen prominent, distended, tympanitic and sensitive. On opening the lower angle of the wound Dr. Kelly was unable to find any evidence of pus. Temperature 104.4°. Jan. 26th, temperature rose to 107.8° and was quickly followed by death. The patient was conscious to the last.

AUTOPSY.

Anatomical diagnosis: Purulent hemorrhagic peritonitis following laparotomy for myomectomy; stitch-hole abscesses; myomata of uterus; acute splenic tumor; embolic lung abscesses; congestion of lungs; infection with streptococcus pyogenes and staphylococcus pyogenes aureus.



Black line indicates temperature. Broken line indicates pulse.

In the mid-line is a linear incision 12 cm. in length, situated between the umbilicus and pubes. The lower angle of this is gaping, but the upper part of the wound is united. On incising the wound, a purulent, sanguineous exudate is found between the skin and the deep muscles, and the muscle wherever exposed is very red. On cutting through the stitches which hold the abdominal walls together, small accumulations of pus are found about the sutures. These foci can be readily distinguished from the general purulent infiltration of the wound. On removing some of the sutures they are found to be covered with pus.

The parietal peritoneum is injected, and on opening it an accumulation of bloody pus is found just beneath the incision. The deep layer of sutures is likewise covered with pus. The omentum is adherent to the intestines and to the parietal peritoneum by adhesions which are easily separated. It is somewhat rolled up, is intensely injected, and is covered with pus on both surfaces. The peritoneum covering the intestines is vividly injected, and there are about 500 cc. of blood in the peritoneal cavity. The blood is partly in the pelvis and in part between the coils of the intestines. The intestines are greatly distended and are covered by a layer of fibrin and pus. In the pelvic cavity, covering the superior surface of the uterus and filling up a large part of the unoccupied pelvis, is a mixture of pus, blood and flakes of fibrin. Along the superior surface of the uterus a row of sutures can be seen. On cutting into the uterus there is a globular cavity approximately 2.5 cm. in diameter. This is filled with blood. Situated near this and deep in the tissue is a catgut suture. There is, however, no pus around it. On removing the superficial uterine sutures, pus can be squeezed in places from the cavities left by them. Both the anterior and posterior cul-de-sacs, more especially the anterior, are covered by a fibrinous exudate; in the anterior cul-de-sac the exudate is thick and hemorrhagic and the fibrinous material can be stripped off from the peritoneal covering. The cavity of the uterus is normal, and in the anterior wall a distance of 5 cm. from the os are two sub-peritoneal myomata, each the size of a hazel-nut. Below these is an interstitial myoma as large as a walnut.

Tubes and ovaries are normal.

Heart weighs 200 grams, apparently normal.

Liver pale and smooth, weighing 1300 grams. Size 20x16x8.5 cm. On section, it is very pale, the lobules being everywhere bright yellow in color. The periphery is of a deeper color.

Both kidneys weigh 275 grams. Size 12x5x3 cm. Capsule stripping off easily. Surface is pale. Cortex 7 mm. thick, very pale. Color of cortex light gray. Glomeruli visible but pale.

Spleen is 10x6x2.5 cm., its capsule being wrinkled. It is soft and on section purplish-red and cloudy. The Malpighian bodies are visible.

Lungs. Both are of the same general appearance. The lower lobes are voluminous and injected. The upper lobes retract somewhat, but have scattered over them at intervals large and small areas in which there is a fresh deposit of fibrin on the pleura. These areas vary in size from that of a split pea to that of an almond, and on section correspond with wedge-shaped areas which are quite superficial. Some of these are hemorrhagic, others are brighter in color and contain a white centre which is surrounded by consolidated lung. In some instances the central portions of these areas are softened, and a small amount of pus can be squeezed from them. They are about equally distributed over both lungs. The lungs are free from adhesions.

Histological Examination. Uterus. The surface of the uterus is covered by a layer of fibrin containing many polynuclear leucocytes and some blood in its meshes. Scattered throughout this exudate are cocci occurring singly, in short chains, or arranged in bunches.

Studding the uterine muscle just beneath the surface are cross sections of catgut ligatures; these stain a homogeneous pink with eosin and remind one of hyaline material. Surrounding each ligature is a zone of polynuclear leucocytes; these are very abundant, and where the ligature presents a flaw have penetrated the abraded surface. The muscle cells in the vicinity of the ligatures are swollen and polynuclear leucocytes are seen wandering in between them. The endothelium of some of the capillaries appears to be swollen. Weigert's fibrin stain reveals organisms in the pus around the ligatures, between the muscle cells in their neighborhood, and also in the small capillaries. In a few places there are small areas of cell necrosis near the ligatures. The cells in these areas stain poorly and show slight polynuclear infiltrations.

Kidney. The capsule is very thin. The glomeruli are in most places separated from their capsule by a space which is filled with a fine granular material. The convoluted tubules are slightly dilated, their epithelium is for the most part intact, some of the nuclei, however, have disappeared and the cell protoplasm is quite granular. Here and there the lumina of the tubules contain fine granules. The picture presented is that of acute degeneration.

Spleen. The Malpighian corpuscles are well defined. The pulp contains a good deal of blood; beyond this the spleen presents nothing of importance.

Liver. The liver is practically normal.

Lungs. Scattered throughout the specimen are large arteries containing hyaline thrombi, a certain amount of blood and large masses of cocci. The alveoli surrounding these vessels are filled with blood, desquamated epithelium and polynuclear leucocytes. In other places the process is more advanced, the artery is nearly filled with polynuclear leucocytes, and surrounding the artery are myriads of polynuclear leucocytes. Many of the smaller vessels are completely filled with cocci, and the branches running off from them are also plugged with the organisms. Areas of lung are seen in which the arteries and their surrounding alveoli contain cocci, but there is not the slightest inflammatory reaction around them. These multiple abscesses of the lungs are undoubtedly due to embolic infection.

BACTERIOLOGICAL REPORT.

Cover-slips from the catgut suture in the subcutaneous abdominal wound show numerous cocci arranged singly, in pairs or in bunches, also occurring in the form of chains. Some cocci were enclosed in polynuclear leucocytes. Cover-slips from the uterus, spleen, liver and kidneys are negative; the small purulent abscesses in the lung contain myriads of cocci arranged in bunches and chains. *The cultures gave staphylococcus pyogenes aureus in the abdominal wound, in uterine muscle, kidneys, spleen and liver, and also in the small purulent areas in the right lung.* Cultures from the fibrin in the pelvis yielded two organisms, a coccus and a bacillus. This coccus on agar-rolls gave pin-point white circular colonies. Cover-glass preparations showed it to be *streptococcus pyogenes*. On potatoes, bouillon and agar-slant it gave the typical growth of *streptococcus pyogenes*. The

bacillus proved to be bacillus coli communis; this organism was also found in the kidneys.

CASE II.

CLINICAL HISTORY.

M. A. C., æt. 45; ward B. Admitted in the service of Dr. Kelly. Menstruation commenced at 16, then disappeared for ten months, after which it was regular. Last menses January 4th. Personal history: Six years ago patient consulted a physician who said she had a tumor, but refused to operate. For the last year she has had occasionally a sharp pain extending from umbilicus to the pubes; the most severe attack was in June, 1891, lasting six days. Family history: Father died of phthisis at 34; mother of dysentery at 64; one sister was operated on here six months ago for sloughing fibroid. *Status præsens*: Patient fairly well nourished, appetite poor, bowels constipated, no headache, but she had a constant feeling of constriction around abdomen; no urinary difficulty; feet are never swollen; is subject to occasional attacks of dyspnœa. The urine is normal.

OPERATION.

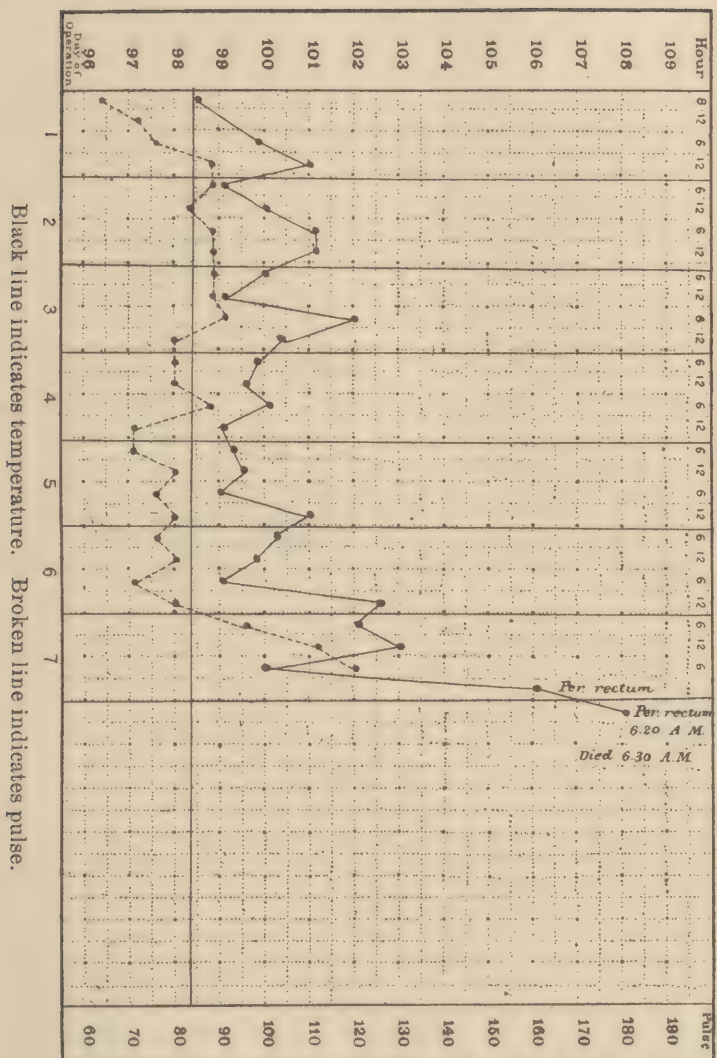
Operation, hysteromyomectomy by Dr. Kelly, January 23, 1893. An incision was made in the abdomen from the umbilicus to pubes. The masses were exposed and drawn out by their shortest diameter. The fundus uteri was just below level of umbilicus. The ovarian vessels could not be tied off near the pelvic brim, as the tumor choked the pelvis. They were therefore controlled on the side of the tumor. Clamps were applied to the uterus laterally, and the vessels cut between the ligatures and clamps. The tumor was now drawn further up and a rubber ligature passed around the mass below. The entire tumor was then cut away, leaving a large flap anteriorly. The uterine vessels were now ligated low down, the flaps trimmed, the uterine canal cauterized, and then closed with catgut ligatures. The anterior flap was united with the posterior surface of the stump. The abdomen was cleaned and closed, four layers of buried and subcutaneous sutures being used. The operation lasted fifty minutes.—January 27, 1893, abdominal incision gaping widely, omentum exposed and bulging. In vesico-uterine

pouch is a collection of dark-colored blood, suggesting purulent contamination. Some little purulent points along abdominal wall were cleansed with hydrogen peroxide. Subiodide gauze was spread over the omentum and the wound surfaces were brought together by eight silkworm-gut sutures. Pulse 100; purulent expectoration; sonorous râles on right side of chest; vomiting for twenty-four hours. January 28, coughing a good deal; no pulmonary consolidation; bowels well moved; the abdomen is now flat and soft, but paroxysmal pain in abdomen is complained of; dressing was changed; omentum covered by a few purulent streaks; temperature 102.6°. January 29, patient complained of abdominal pain; tongue moist, but heavily coated. 1.30 A. M., pulse 96, temperature 103.3°. 10 A. M., thin yellow pus from wound was removed by hydrogen peroxide; abdomen distended, tympanitic, not sensitive; expression of countenance dull; coarse moist râles at bases of both lungs. 7 P. M., temperature 100°; pulse 130, weak; perfectly conscious; abdomen markedly distended; has vomited four times during afternoon; vomited material of a dirty pale-brown color. 10.30 P. M., pulse very small, weak; she has muscular twitchings, is slightly delirious, but will answer questions if spoken to; temperature per rectum 106°. Jan. 30th, 6 A. M., temperature per rectum 108.2°; patient died unconscious.

AUTOPSY.

Anatomical Diagnosis: General fibrinous peritonitis following abdominal hysterectomy; chronic diffuse nephritis; acute splenic tumor; fatty degeneration of the liver; infection with staphylococcus pyogenes aureus and bacillus pyocyaneus.

Only a partial autopsy was permitted. The abdominal incision is gaping and the omentum is exposed after removing from the wound the gauze drain. The edges of the wound are reddened and oedematous and are covered with a thin film of pus. The omentum is swollen, injected, and covered with an exudate. The intestines beneath the wound are in places covered with a white or whitish-yellow fibrinous exudate, and the peritoneal coat is injected. The exudation is more abundant between the intestinal loops. The loops in the pelvis are firmly glued together by a fibrinous exudate which in places is hemorrhagic. On opening the distended intestines the mucous membrane does not present any remarkable appearance. One kidney was removed; weight 160 grams. Its dimensions are



12x6x3.5 cm ; average thickness of cortex 8 mm. The capsule is removed with some difficulty, bringing small bits of kidney substance along with it. The surface is finely granular, with here and there smooth areas. It is pale-gray and the stellate veins are prominent. On section the cortex is pale, the striæ are coarse.

Spleen. Weight 150 grams. Dimensions 12x6.5x2.5 cm. Capsule is wrinkled and covered with an opaque whitish-yellow fibrinous exudate. On section it presents a mottled appearance, its Malpighian bodies are visible, and the pulp is abundant.

The liver is covered with a dense opaque fibrinous coat which cannot be scraped off. On section it is pale and the consistency is somewhat diminished.

HISTOLOGICAL EXAMINATION.

Kidney. The capsule is somewhat thickened, the connective tissue between the tubules is slightly increased. The glomeruli are contracted and the spaces between them and their capsules are filled with granular material. The epithelium of the convoluted tubules is granular and the lumina of the tubules are filled with a granular substance. There is evidently an acute parenchymatous nephritis associated with a slight interstitial nephritis.

Spleen. The capsule is considerably thickened. On its outer surface is a delicate membrane composed of cells whose nuclei are round, oval or irregularly triangular. There are also a few polynuclear leucocytes scattered throughout it. Weigert's fibrin stain revealed a few cocci in this membrane ; these cocci are arranged either in clumps or short chains. Many of the lymph nodules contain masses of hyaline material ; these do not give any amyloid reaction with Lugol's solution or with methyl violet. Some of the lymph nodules are enlarged and contain 3 or 4 giant cells. These giant cells contain many oval nuclei which are either arranged around the margin of the cell or are situated in its center. Surrounding the giant cells are epithelioid cells, while encircling these again are lymphoid cells. In other parts of the spleen are areas occupied by large numbers of giant cells. There are no foci of caseation. The spleen pulp contains a good deal of blood. Notwithstanding our inability to find tubercle bacilli, this presents the typical appearance of miliary tuberculosis.

Liver. The liver shows slight passive congestion.

BACTERIOLOGICAL REPORT.

Cover-slips from the foci of pus on the peritoneal surface of the abdominal wall, from the peritoneal cavity and between coils of intestines, contain numerous staphylococci. Those from the liver yield a few diplococci, and a few cocci occur singly. Cover-slips from the kidney and spleen negative. *Cultures from the foci of pus in the abdominal wall, from the peritoneum, and also from the kidney, give staphylococcus pyogenes aureus*, which produces moderate liquefaction of gelatin in 24 hours at 20° C. The peritoneal cavity also contains a bacillus about three times as long as broad; its ends are rounded, and it occurs in chains of two or three, or is found singly. It is actively motile, being propelled by a wave-like movement.

Agar-rolls, after 24 hours, at 37° C. yield numerous pale white moist circular colonies. Examined with a low power, the colonies appear light brown, are granular, and have well-defined margins. A very offensive odor is emitted on removing the plug from the tube. Agar-stab, after 48 hours, at 37° C. gives an abundant thick white moist growth on the surface, but scantier in the depth of the medium. The upper half of the agar is greenish in color, but remains translucent. The green color deepens with age, and gelatin-slants kept at the room temperature become partially liquefied after 24 hours. The liquefied areas are turbid and tinted with green. Liquefaction is complete in four days. Litmus milk, 37° C., is slightly decolorized and firmly coagulated in 48 hours. Sugar-agar, 37° C., gives an abundant flat, moist, white growth in 48 hours. There is no gas formation. Bouillon, 37° C., is diffusedly turbid, contains a coarse white granular precipitate, and is tinged slightly green in 48 hours. Diagnosis: *bacillus pyocyaneus*.

CASE III.

CLINICAL HISTORY.

M. P., æt. 65, admitted in the service of Dr. Kelly, Jan. 13, 1893. The patient had been married 38 years, four para, labors not instrumental. Menses commenced at 15, were always regular, ceased when she was 50 years of age. About Dec. 1890 her abdomen began to enlarge; this swelling was most marked on the right side. It was not associated with any pain, and her general health was good. The

abdominal enlargement gradually increased, and in March, 1892, the feet and ankles commenced to swell. There was, however, no general anasarca. Micturition was frequent; the patient at times had to get up at night. On inspection the abdomen was greatly distended. Measurements: circumference at umbilicus 120 cm., three inches below umbilicus 126 cm. Distance from ensiform cartilage to umbilicus 25 cm., from pubis to ensiform 18 cm., from left anterior superior spine to umbilicus 26 cm., from right anterior superior spine to umbilicus 20 cm. The tumor appears to be divided into two parts by a depression extending from the tips of the floating ribs diagonally across the abdomen to a point about one inch below the umbilicus. On percussion: dullness extends upward 5 cm. above umbilicus in the midline. The corona of resonance is well marked. A distinct wave of fluctuation can be elicited. Per vaginam: outlet much relaxed; cervix 7.5 cm. from outlet, hard, flush with vaginal wall; tubes and ovaries not palpated.

OPERATION.

Operation by Dr. Kelly, Jan. 19th, 1893. An incision 6 cm. long was made in the abdominal wall. This exposed a thin-walled cyst which contained seven litres of a blackish fluid. After drawing off the fluid it was found that the cyst was adherent to the anterior abdominal wall over an area of 9x9 cm. It was also universally adherent to the pelvic wall, to the left tube and broad ligament, and to the entire posterior surface of the uterus. Enucleation was begun by tying off the tube and uterine vessels at the right cornu. On cutting away this tube, the collateral circulation was controlled by immediate ligation of the uterine artery at brim of the pelvis. Later on it was necessary to control the artery about 2 cm. below the body of the uterus near the cervix. The pelvis was irrigated with salt solution. In order to obliterate the bare surface on the posterior part of the uterus, on the pelvic floor and broad ligament, the uterus was forced backward into Douglas' pouch, leaving nothing exposed but its smooth anterior surface. A gauze drain was then placed in the lower angle of the wound. Catgut ligatures were used throughout the operation.

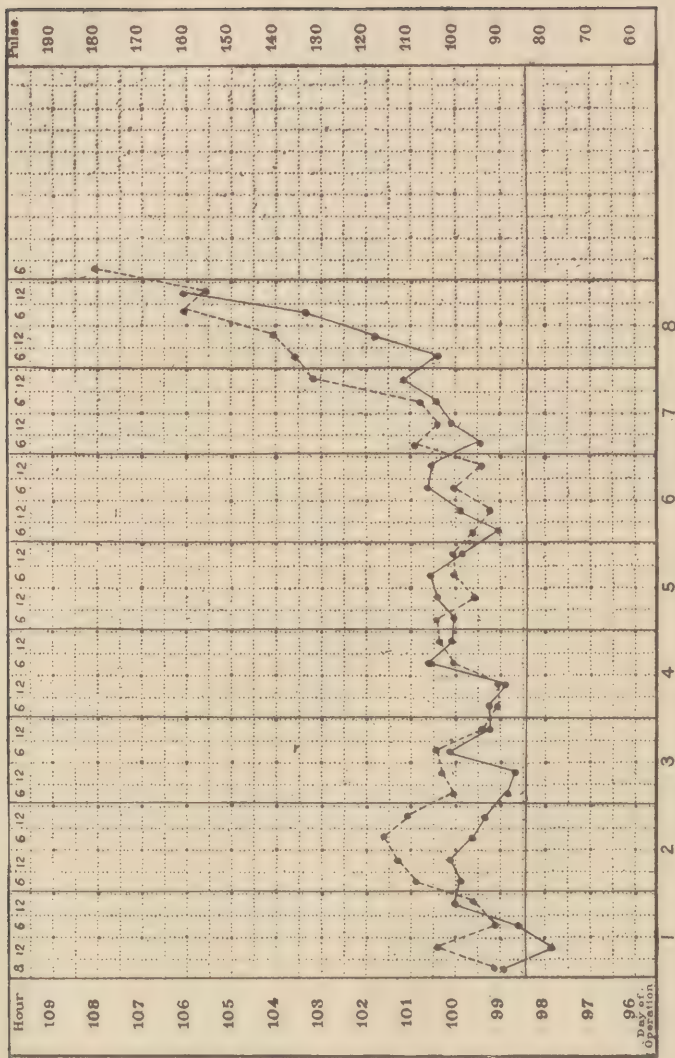
Jan. 20th. During the night about three ounces of bright bloody discharge escaped from the wound. The removal of the gauze drain

was accompanied by a great deal of pain and was followed by a discharge of bright blood. The provisional sutures were then tied. Expression of countenance was good, tongue very dry and corrugated, abdomen flat, pulse slightly intermittent.

Jan. 21st. Tongue dry, abdomen slightly distended, pulse 120, dicrotic, temperature 99.4°. Jan. 25th, sutures removed, union good, no suppuration, abdomen perfectly flat. Jan. 26th, abdomen markedly distended over the region of the stomach, the outline of which can be easily seen. The tongue dry and cracked, pulse 144. The patient has been vomiting a greenish fluid. Up to last evening she had been doing well, since then the abdominal distension has been accompanied by much pain. In the evening the pulse rose to 160, temperature 101.8°. Strychnia, one-fortieth of a grain, was given every four hours. Brandy and nutritive enemata were also given every four hours. Jan. 27, extremities cold, no radial pulse, tongue dull red and fissured. Pupils were widely dilated, patient was perfectly conscious. Temperature rose to 107.8° and death soon followed. Last temp. not recorded on chart.

AUTOPSY.

Anatomical Diagnosis: General peritonitis following removal of an ovarian cyst; congestion of lung; acute splenic tumor; chronic diffuse nephritis; dermoid of ovary (?); infection with *staphylococcus pyogenes aureus* and *albus*. In the median line is a linear incision 12 cm. long, which is healed externally. On incision the underlying tissues present nothing of especial interest, except a single drop of pus in the muscles just external to the peritoneum. Owing to the fact that the autopsy was hurried and that the organs were removed through the abdominal incision, it is impossible to tell whether this pus was in any way connected with a suture. The uterus is covered with old adhesions on both surfaces. Douglas' cul-de-sac is covered by a thick layer of fibrin, and on stripping this away the underlying tissues are found to be hemorrhagic. The appendages on the right side are absent, and only a stump of the right tube remains. This is firmly controlled by ligatures. On the left side the ovary is adherent to the broad ligament, and springing from its outer extremity is a cyst 3.5x2x1 cm. This is filled with bloody contents, the inner wall having delicate papillary projections springing from it. In the outer end of the ovary is a small hard body about



Black line indicates temperature. Broken line indicates pulse.

the size of a pea, irregular in shape, perfectly smooth, and covered superficially with a thin membrane. It may be a tooth. Liver has a smooth surface and is exceedingly pale. On section it presents a mottled appearance, having a yellowish ground streaked with red lines.

Spleen. Weight 125 grams, dimensions 11x7x3.5 cm. The capsule is wrinkled and slightly thickened in places. Here and there small nodules the size of a poppy-seed are visible beneath the capsule. On section similar nodules, yellowish in color, are seen in the substance of the organ; these are sharply circumscribed. The spleen pulp is abundant.

Kidney. Combined weight 430 grams; dimensions are 11x6.5x4 cm.; thickness of cortex 6 mm. The capsule is slightly adherent, and the surface of the kidney presents a granular appearance corresponding with the adhesions of the capsule. A number of cysts are found beneath the capsule and in the substance. Some of these are as large as a hazel-nut. The cortex and pyramids are pale, and the striæ of the cortex are obliterated. A few punctate calcareous infarcts are present in the pyramids.

Heart. Weight 225 grams; valves normal; there is a moderate amount of fresh fatty change in the intima of the aorta above the valves.

Left lung. Apparently normal; right lower lobe congested and voluminous, and contains a hard calcified nodule the size of a hemp-seed. This is surrounded by a puckered cicatrix.

HISTOLOGICAL EXAMINATION.

The liver shows slight passive congestion, but is otherwise normal.

The spleen pulp contains large quantities of blood.

Kidney. The capsule is somewhat thickened, presents a granular appearance, and contains a few spindle-shaped nuclei. There is slight increase of connective tissue throughout the kidney which is more marked in some places than in others. Many of the glomeruli fill up their spaces entirely and appear to have become fibrous. The convoluted tubules are slightly dilated, their nuclei are in most places present, but some have disappeared. The cell protoplasm is granular and it is difficult to differentiate one cell from another. The epithelium of Henle's and of the collecting tubules is intact;

some of the tubules, however, contain hyaline casts. The cyst-like cavity seen macroscopically has a thin wall of fibrous tissue the nuclei of which are round, oval or spindle-shaped. In close proximity to the cyst wall is the unaltered kidney substance. The kidneys undoubtedly show chronic diffuse nephritis with slight cystic degeneration.

BACTERIOLOGICAL REPORT.

Cover-slips from the drop of pus in the abdominal wound and from the peritoneal exudate showed numerous cocci, chiefly in pairs. *Cultures from the peritoneum gave staphylococcus aureus and albus. The aureus appeared to predominate.*

CASE IV.

CLINICAL HISTORY.

M. E. A., æt. 29, admitted in the service of Dr. Kelly, Jan. 20, 1893. Complaint: painful menstruation, accompanied by a feeling of distress in the abdomen after eating. The patient has been married eight years. No children and no miscarriages. Menses commenced at 14, were regular until four years ago, since then they have been scanty and painful. Last menstruation Jan. 4th. She had gout four years ago. *Status præsens:* patient is fairly well nourished, bowels constipated, micturition frequent and painful, leucorrhœa profuse.

OPERATION.

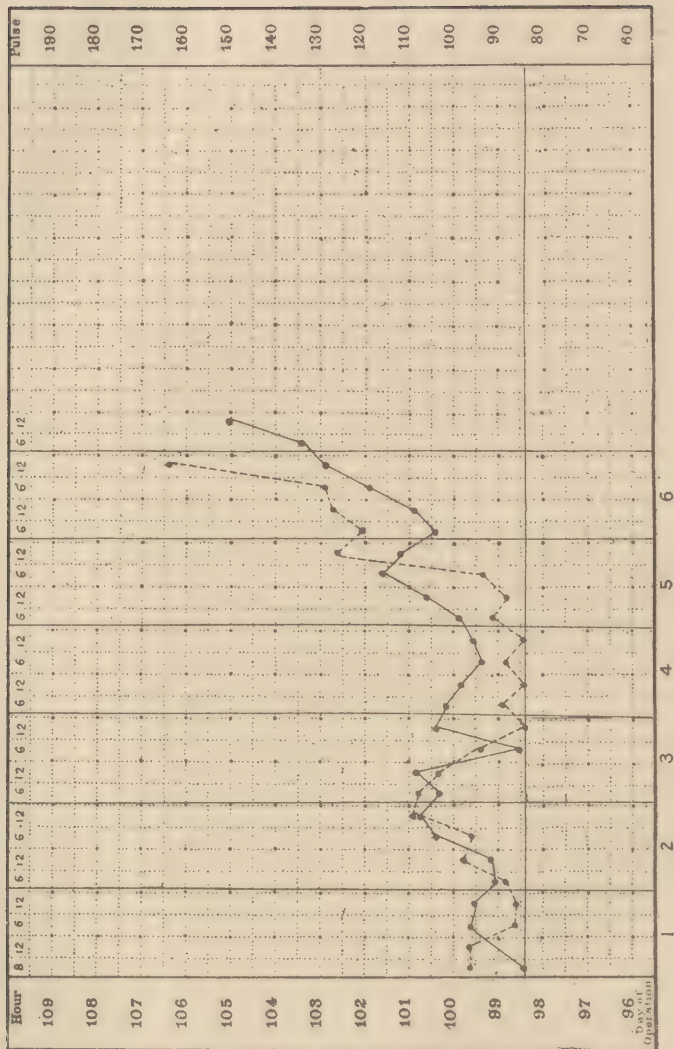
Operation by Dr. Kelly, Jan. 21st. An incision 7 cm. long was made through moderately thick abdominal walls. On opening the cavity three or four ounces of blood-stained serum escaped, which coagulated on exposure to the air. After enlarging the abdominal incision 6 cm. the right tube and ovary were enucleated from a bed of delicate adhesions, and were tied off by interlacing sutures of medium size. The tube was dilated and contained about 200 cc. of a clear fluid. The left tube and ovary were released from dense adhesions to surrounding structures and were removed, the pedicle being controlled by interlacing silk sutures. The ovary was torn at the hilum during removal. The left tube was somewhat thickened and inflamed. The abdominal cavity was irrigated with

salt solution of a temperature of 112°. It was then sponged out and closed without drainage. Duration of operation 22 minutes. Cat-gut ligatures were also used in this case to approximate raw surfaces in the pelvis.

Jan. 25th, temperature 101°. The abdomen was much distended; a rectal tube was passed, but with no relief of the distension. Considerable flatus was expelled at different times during the day. Tongue was dry and she cried out with pain. Early in the morning the pulse was 96, towards evening it had increased to 112 and had diminished in volume. Two grains of calomel were given and frequent doses of strychnia. Jan. 26th, patient restless at times. Temperature 102°. Pulse 168. At 10.30 A. M. the abdominal stitches were removed. The edges of the wound immediately retracted and pus was seen oozing from the stitch-holes. This apparently relieved the patient considerably. Jan. 27th, cover-slips from the blood showed no organism. Temperature rose to 106.4° and patient still remained conscious. 7.30 P. M. patient was screaming with abdominal pain, became slightly delirious and died at 8.45 P. M. Before operation the urine was normal; two or three days before death it contained a great deal of albumen and hyaline casts. Last temp. not entered on chart.

AUTOPSY.

Anatomical Diagnosis: General peritonitis following removal of both tubes and ovaries; stitch abscesses; syphilitic deformity of the liver; gummata in liver; congestion of lungs; chronic diffuse nephritis; amyloid infiltration of kidney, liver and spleen; infection with *staphylococcus pyogenes aureus*. In the median line of the abdomen is a linear incision 10 cm. long. The lower 3.5 cm. of this is gaping, and on removing the stitches they are found to be covered with pus. Pus can also be squeezed from the stitch-holes. The muscle, where exposed, is covered with pus, and at the superior angle of the wound, where the muscular layers are separated from one another, is a cavity containing pus. The omentum contains a considerable quantity of fat, is injected, and adherent by its outer surface to the abdominal wound; on its inner surface to the intestines contained in the pelvis. Its under surface over the lower third of its extent is intensely injected, cedematous, and cloudy from the presence of pus. Along its inferior border it is greatly swollen and covered with a fibrino-purulent



Black line indicates temperature. Broken line indicates pulse.

exudate. Between the coils of intestines in the pelvis, and also on the parietal peritoneum corresponding to them, are dense masses of fibrin. The large intestine occupies the inferior portion of the pelvis, and its coils are more firmly adherent than the other portions of the intestine. Over the general peritoneal surface of the intestines is a very delicate deposit of fibrin. About 20 cm. above the ileo-cæcal valve a loop of intestine 12 cm. in length is folded upon itself and covered with a thick fibrinous deposit which can be readily stripped off. This deposit commences at the mesenteric border of the gut and extends two-thirds of the way around it. The peritoneal surface beneath the fibrin is deeply injected and roughened. A little mass of fat at this point is swollen and œdematous. The peritoneal coat of the lower portion of the colon is intensely injected and covered with hemorrhagic masses of fibrin. The gut is considerably distended and contains fluid yellow fæces. The mucous membrane of the small intestine is somewhat injected; opposite the loop above mentioned this is especially marked. The mucosa of the large intestine is pale and the rectum is congested. The middle portion of the appendix is bound down by old adhesions, but is otherwise normal.

Both uterine appendages are missing, being represented by stumps on either side of the uterus. These stumps are covered with hemorrhagic masses of fibrin, and on section are seen to be suffused with blood. The anterior cul-de-sac is lined by a thin layer of fibrin and there are evidences of old adhesions. On the superior surface of the uterus there are also old adhesions, and between the posterior surface of the uterus and the anterior surface of the rectum similar adhesions are found. The peritoneum in the posterior cul-de-sac is also covered by fibrin. The cavity of the uterus is normal. Bladder is normal.

Mucous membrane of the stomach is pale, but there are a few areas of congestion.

Liver weighs 1600 grams. Size 25x17x9.5 cm. There are perihepatic adhesions to the abdominal wall and diaphragm, and there are large elevated areas with corresponding depressions, thus giving the liver a lobulated appearance. The lobulations vary from one half to ten centimeters in size.

The gall-bladder is thickened and is bound down by old adhesions. The liver on section is mottled, presenting congested and pale yellow

opaque areas. Bands of dense white tissue run between the lobulations, and the portal veins appear to be dilated. Scattered throughout the liver are many gray translucent and yellow foci, the largest being the size of a poppy-seed.

Kidneys. Combined weight 340 grams. Size 12x6.5x4 cm. Capsule strips off readily. The surface is slightly irregular, presenting atrophic areas. The veins are injected, and on section the pyramids are seen to be injected. The cortex is 8 mm. thick, is pale, and its striæ are in part obliterated; where present they are very fine. Malpighian bodies are prominent and red. The whole organ is œdematous.

Lungs. Both are alike, retract, and the edges contain air and are slightly emphysematous. The rest of the lung is deeply injected, the pleura dark in color. The bronchi are free, greatly injected, and contain a slight amount of tenacious mucus. The blood-vessels are free, and the bronchial glands are deeply pigmented and œdematous.

The heart weighs 220 grams and is apparently normal.

The spleen is 13.5x8x3 cm. There are a few old adhesions on the capsule and the organ is firm. On section the trabeculæ are visible, but few Malpighian bodies can be seen.

The pancreas is apparently normal. Mesenteric glands swollen and congested.

HISTOLOGICAL EXAMINATION.

The liver tissue is divided up into foci of one or of several lobules, and occasionally into fractions of lobules, by dense masses of connective tissue. The liver cells are granular, swollen and often fatty. Circumscribed areas of necrosis of variable size are found which correspond to those seen by the naked eye. In some places these areas are surrounded by a zone of fatty cells, but there is no connective tissue capsule. In others there is a distinct capsule. Scattered throughout the liver are small masses of necrotic cells. The capillaries running between these contain a good many polynuclear leucocytes. The dense bands of connective tissue which are scattered throughout the liver contain numerous blood-vessels, the walls of which present a hyaline and glistening appearance. Stained with Lugol's solution this glistening material gives the characteristic amyloid reaction. These are probably syphilitic gummata.

Kidney. The vessels in the pyramids and in some of the glomerular capillaries give the amyloid reaction.

BACTERIOLOGICAL REPORT.

Cover-slips from peritoneum and kidneys were negative, but cultures from the peritoneum gave *staphylococcus pyogenes aureus*. The same organism was found in the subcutaneous portion of the abdominal wound in a catgut ligature from the deep part of the abdominal wound, and from the omentum just beneath the incision.

1.5 cc. of a 48-hour bouillon culture of this organism, introduced into the ear vein of a rabbit, caused the death of the animal in five days.

The lung contained a short bacillus with rounded ends, about half as long again as broad. On cultivation on agar, gelatin, acid gelatin, potato, and in litmus-milk, it closely resembled the bacillus coli communis, but it was not positively identified.

Kidney, spleen and liver were sterile.

CASE V.

CLINICAL HISTORY.

Emma B., admitted in the service of Dr. Kelly, Jan. 16th, 1893.

This patient, who recovered, was operated upon by Dr. Kelly, Jan. 18th, both tubes and ovaries being removed. The tubes contained a milky-like pus, some of which escaped into the abdominal cavity. In the abdomen silk ligatures were used, while the abdominal incision was closed by three layers of catgut. No drainage. Several days after operation the temperature rose, the wound became indurated and then broke down, a small amount of pus discharging, the wound then healing. An induration in the left broad ligament was detected, which persisted and had not disappeared when the patient left the hospital on March 12th. Her highest temperature was 102.2°.

ANALYSIS OF THE FATAL CASES.

NATURE OF THE OPERATION IN THE FATAL CASES.

Case 1. Myomectomy which consisted in making an incision over the myomatous nodules and shelling them out of their beds. Operation easy.

Case 2. Hystero-myomectomy. Operation easy.

Case 3. Removal of an ovarian tumor densely adherent to the abdominal wall and to left tube and broad ligament. Gauze drain left in lower angle of wound on account of capillary oozing from the adhesions. Operation difficult.

Case 4. Removal of right tube and ovary for hydrosalpinx, left tube and ovary because densely adherent. Operation easy. •

POST-OPERATIVE SYMPTOMS.

Abdominal pain was one of the first and at the same time a most striking feature. It was paroxysmal in character and occurred in every case. The pain was soon followed by a dryness of the tongue associated with fissures; two of the four manifested this symptom. Nausea was present in three cases, the vomit being greenish or pale dirty-brown in color. Tympany was a constant symptom, appearing to be intimately associated with the abdominal pain. It was transitional in character. It will be noted from the charts that there was a marked uniformity in the temperature curves. In some the rise commenced on the third day, in others not until the seventh; in all, however, the sudden rise before death was approximately the same, the temperature varying between 105°-108°. A mild delirium preceded death in two of the cases; the other patients were conscious until the last.

PATHOLOGICAL REPORTS.

In the majority of the cases only a partial or a hurried autopsy was allowed, which will account for the scanty data in some portions of the report.

Macroscopical appearances. In Cases I, II, IV the abdominal incision had been reopened before death, and at autopsy the gaping wound was found covered by a purulent exudate. In Case III the wound had healed, but a drop of pus was found along the line of incision just external to the peritoneum.

Every case showed the intestines and the peritoneum to be covered by a fibrino-purulent exudate which could be easily stripped off. The exudate was also present on the omentum. In Case I, 500 cc. of pus mixed with blood were found in the abdominal cavity.

The uterus in Case I contained catgut ligatures, on the removal of which pus could be squeezed from the stitch-holes.

The spleen in Cases I, II, III presented an acute splenic tumor, the tissue being very soft and friable. In Case IV the spleen was equally enlarged but firm.

The kidneys did not present much change. In Cases II, III, however, the capsules were somewhat adherent, and in the latter a few small cysts were visible.

Liver. Case IV had a markedly lobulated liver, bands of white glistening tissue dividing it up into lobules, while scattered throughout the organ were many translucent gray and yellow foci, the largest of which was the size of a poppy-seed.

Heart. The heart was examined in all cases and found to be normal.

HISTOLOGICAL EXAMINATION.

Uterus. In Case I the surface of the uterus was covered by fibrin which contained many polynuclear leucocytes, and cocci arranged in chains. The catgut ligatures in the depth of the uterine muscle were surrounded by polynuclear leucocytes, and scattered throughout the pus were many cocci. The muscle in the vicinity was somewhat infiltrated with polynuclear leucocytes, and there was a small amount of cell necrosis.

Kidneys. Cases I and II revealed acute parenchymatous nephritis, while Case III showed chronic diffuse nephritis. In Case IV the pyramidal vessels and glomerular capillaries gave the characteristic amyloid reaction.

Spleen. The capsule of Case II showed proliferation of the peritoneal cells, which were swollen, in places two or three layers in thickness, while scattered between them were polynuclear leucocytes and cocci.

Liver. The liver in Cases I, II and III was practically normal. Case IV showed marked cirrhosis with gummata.

Lungs. In Case I the abscesses described were found to be embolic in origin and to contain many cocci.

BACTERIOLOGICAL REPORT.

Cover-slips. In Case I cocci were found in the abdominal wound and in the lungs. These were arranged in pairs, bunches or chains.

Case II showed cocci in the abdominal wall, peritoneal cavity, between the coils of intestines and in the liver.

Case III. Cocci arranged chiefly in pairs were found in the abdominal wound and in the peritoneal cavity.

Case IV. Cover-slips from the peritoneal cavity were negative.

Cultures. *Staphylococcus pyogenes aureus* was present in Cases I, II, III and IV, being the predominating organism in each instance. In Cases I and II it was widely disseminated, being found in the different organs.

Streptococcus pyogenes was present in the pelvic cavity in Case I; *bacillus pyocyaneus* in the abdominal cavity of Case II.

Staphylococcus pyogenes albus in the abdominal cavity of Case III. *Bacillus coli communis* in pelvis of Case I.

Virulence of the Organisms. 15 cc. of a 48-hour bouillon culture of the *staphylococcus aureus* in Case IV was introduced into the ear vein of a rabbit. The animal died on the fifth day with multiple abscesses.

The most interesting evidence of the virulence was afforded by those taking part in the autopsies. Four persons were engaged in assisting or in making the autopsies and each one showed infection of the hands. In one case multiple pustules formed. Dr. Flexner, who was more exposed than the others, developed a very painful abscess under a finger-nail. A cover-slip was made and immense quantities of cocci were found. On cultivation the organism proved to be a pure culture of *staphylococcus pyogenes aureus*.

CAUSES OF PERITONITIS.

Peritonitis is now regarded as being almost invariably due to pathogenic organisms. It has, however, been stated that chemical agents may cause inflammations of the serous membranes, notwithstanding which Grawitz and Klemperer assert that micro-organisms are essential to the process.

It is now known that a variety of micro-organisms in addition to the pyogenic staphylococci and streptococci may act as simple pus producers, and presumably may be the cause of peritonitis. Among these are the *bacillus pyocyaneus* (Kraft and Barker); *bacillus proteus* (Flexner); *bacillus typhosis* (A. Fraenkel); *Bacillus coli communis* (Fraenkel and Welch), and the *diplococcus lanceolatus*

(Weichselbaum). Moreover, there are not a few instances in which a mixed infection has been observed. The organism present will depend entirely upon the one introduced.

FUNCTIONS OF THE PERITONEUM. We know from the experiments of Wegner that the peritoneal surface is practically equal to that of the skin and that it possesses two important functions, those of *absorption* and *exudation*. He demonstrated the fact that the peritoneal cavity of a dog could absorb an amount of fluid equal to 3 to 8 per cent. of the body-weight in one hour, and that under reverse circumstances an exudation equal to 4 to 8 per cent. of the body-weight might occur in a similar period. We should bear these facts in mind in the consideration of peritonitis.

EFFECTS OF PATHOGENIC ORGANISMS IN THE NORMAL PERITONEAL CAVITY.

Grawitz, Welch, Halsted, Waterhouse and Reichel have introduced moderate quantities of pathogenic organisms into the abdominal cavity of animals and found that the animals remained perfectly healthy. In opposition to these results is Pawlowsky, who asserts that small quantities of pathogenic organisms are capable of producing peritonitis. Waterhouse found that small quantities of blood could be poured into the abdominal cavity with impunity, but that in those cases where *staphylococcus aureus* was introduced soon after the blood, peritonitis developed.

Halsted placed sterilized potato in the peritoneal cavity, with negative results in every instance; in those cases, however, where the *staphylococcus aureus* and the potato were introduced together peritonitis invariably developed.

The experiments of Welch and Howard to test the effects of *staphylococcus aureus* on blood-clots have a definite bearing in this connection. They chiseled a cavity in the femur of dogs and allowed a blood-clot to form and inoculated it with *aureus*. The blood-clot was in no way affected, and underwent the usual transformation. The *staphylococci* survived for many days, but did not appear to multiply.

Mikulicz from a clinical standpoint says that frequently small collections of blood occur in spaces left in the pelvis after abdominal operations, for instance where an interstitial myoma has been shelled

out. These spaces he terms "dead spaces" and claims that blood forms a very favorable medium for the development of the organisms should they be present.

Welch and Howard ligated the omentum and inoculated the peritoneum with *staphylococcus aureus* with varying results. In some, general peritonitis followed; in others, localized foci of inflammation occurred, while in some the result was negative.

In summing up the effect of pathogenic organisms on the peritoneum, both in human beings and in animals, we would quote the conclusions arrived at by Prof. Welch in the paper already several times referred to:

"It is apparent that while there is no reason to doubt that pyogenic cocci are specific agents of infection, the effects which they produce depend upon a variety of conditions, such as the source, the number, and the virulence of the micrococci, the accompanying toxic substances, the part of the body invaded, the readiness of absorption, the presence of foreign bodies and of pathological products, the general state of the patient, and the condition and handling of the wounded tissues."

HOW THE ORGANISMS GAIN ENTRANCE TO THE ABDOMINAL CAVITY.

First, they may be contained in the air and accidentally drop into the abdomen.

Ullmann has shown that the staphylococci are usually found in rooms that are in continual use, also that they are more abundant in summer than in winter. Now applying the experiments of Grawitz, Waterhouse, Welch and Halsted to man, we see that the peritoneal cavity may under ordinary circumstances be able to take care of these organisms; if, however, some "dead spaces" be present, peritonitis may follow.

Second, the hands of the operator and assistants may have pathogenic organisms on them, and we can easily see how the operator, if not careful, may carry them from one patient to another.

Third, the instruments and sutures may be the carriers of the organisms. The former are now so easily sterilized by boiling that they need not be considered. We know that while silk and silkworm-gut can be boiled in water or steamed, catgut is destroyed

by the same process, hence our surest method of sterilization is unavailable.

Various methods aiming to render catgut aseptic have been adopted, viz., the employment of carbolized gut as used by Lister, chromic acid catgut which he afterward employed, the juniper oil catgut of Kocher, the bichloride gut of Kümmel and the Reverdin catgut.

Brunner, who has undoubtedly written the most careful monograph on the preparation of catgut, communicated with many surgeons of Germany to learn their experience with the various preparations of the gut. Kocher of Bern in a period of seven weeks had thirty-one major operations, of these twenty-two were infected, the infection consisting in abscesses, localized phlegmon and diffuse suppurations, carbolized and sublimate catgut having been used.

Zweifel, Mosetig Moorhof and Hafter reported fatal cases. It should not be forgotten that peritonitis in these cases may have been due to some other mode of infection, and for positive statements bacteriological examinations of the catgut should have been made. Schede, Thiersch and Brunner speak most favorably of the use of catgut.

SOURCE OF INFECTION IN THE ABOVE CASES.

From the fact that the *staphylococcus pyogenes aureus* (which was the predominating organism) occurred in every case, and since all the fatal cases took place at one time, the conclusion seems unavoidable that the source of infection was the same in each instance. The technique of the operating-room was the same as formerly save in one particular. The catgut which had hitherto been placed in 95 per cent alcohol and sterilized by steam was very friable and it was suggested that juniper oil catgut be employed. The gut was put in a screw-top glass jar containing equal parts of juniper oil and 95 per cent alcohol and placed in a steam sterilizer for half an hour on each of three consecutive days. This gut was employed in all the septic cases, and unfortunately every strand was used during the operations. It will be noted that all cases in which it was used showed untoward symptoms, four of them dying; also that in Cases I and II, in which the moist catgut was used, the severest symptoms were manifested. These circumstances naturally

make one suspicious of the catgut, but as all the gut was used during the operations, no bacteriological examination could be made, and hence we are not warranted in making any positive statements as to the part played by the catgut in the production of the peritonitis. The uniformity of the symptoms in each of the cases is of interest, especially since in all instances the same organism was the exciting factor. In conclusion I wish to thank Dr. Flexner for his assistance in the preparation of this paper.

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